

circulated, and expounded in the following year. The precaution was nevertheless insufficient to prevent a claim to priority being put forward. Dr. Wallis, the Savilian Professor of Geometry, prepared on behalf of his friends Wren and Neile, a storage-battery of fame in the shape of a counter-anagram, which—if Huygens's private notes are to be relied upon—he fraudulently interpreted as an announcement similar in purport to that imparted to him from the Hague. Some unexplained circumstance possibly underlies a transaction on the face of it highly discreditable to our countrymen. The pretensions of the English observers were at any rate quickly and quietly withdrawn, and Huygens was left in undisturbed enjoyment of the credit most justly due to him.

Shortly after his return from Paris, late in 1655, he constructed a telescope of 23 feet, magnifying one hundred times; and the comparison of the observations it afforded him with those of the previous year enabled him at once to penetrate the mystery of Saturn's enigmatical appendages. His hypothesis as to their nature, wrapt up in the customary logogryph, was appended to his little tract on the Saturnian satellite, with an accompanying prediction of the future changes of figure to be expected in the planet. Its verification, however, falls outside the limits of the publication we are at present concerned with. Nor does it include any mention of the novel sight disclosed to Huygens by his improved instrument in the constellation of Orion, where a certain "hiatus" in the firmament permitted (as he supposed) the pure, faint splendour of the empyrean to shine through on his amazed vision.

Huygens had an eminently sane and sagacious mind. His fortunate intuitions were numerous, and the investigations they suggested were singularly solid and complete. A great part of his work was thus fitted to be, and has actually become, the substructure of the modern scientific edifice. He was, however, less happy in the few cases in which, relaxing his habitual prudence, he gave the rein to speculation. His prevision that the measure of discovery in the solar system was filled by the disclosure of Titan, was belied with scarcely civil haste by Cassini's further detections hopelessly overthrowing the numerical balance between six primary and six secondary bodies. And the surmises which constituted the bulk of his "*Cosmotheoros*" were, for the most part, infelicitous. Yet he reprehended, as woven out of figments, the Cartesian theory of the origin of the universe, and concluded with the wise and memorable words:—"To me it would be much if we could understand how things actually are, which we are far enough from doing. How they were brought about, what they are, and how begun, I believe to be beyond the range of human ingenuity to discover, or even by conjectures to approach."

A. M. CLERKE.

NORWEGIAN GEOLOGY.

Bömmelöen og Karmöen med Omgivelser. Geologisk beskrevne af Dr. Hans Reusch. (Kristiania: Published by the Geological Survey of Norway, 1888.)

THE attention of geologists in all parts of the world has for some years been concentrated upon the crystalline schists, which have so long presented insuper-

able difficulties to those who would explore their origin. Little by little the darkness has been rising from these ancient foundation-stones of the earth's crust; and though a long time must probably still elapse before their history can be even approximately sketched, there can be no doubt that we are now at last on the right road of investigation. Fresh evidence is continually being obtained from the most widely-separated regions, and each additional body of facts goes to support the view that the schistose rocks are the records of gigantic terrestrial displacements, whereby portions of the crust have been pushed over each other, and so crushed and deformed as to acquire new internal rock-structures. Out of these mechanical movements, with their accompanying chemical transformations, a true theory of metamorphism will no doubt eventually be evolved. In the meantime it is too soon to generalize; what we need is a far larger mass of observations. The subject is a wide one, for it involves the labours of the field-geologist, the petrographer, the mineralogist, the chemist, and the physicist. And only by the united exertions of these fellow-workers can we hope for good progress and solid results.

The most recent contribution to the question of the origin of the crystalline schists has just appeared in the form of a handsome volume, by Dr. Hans Reusch, on the Bömmel and Karm Islands off the mouth of the Hardanger Fjord. It consists of a mass of detailed observations on the structure of the crystalline rocks of that part of the Scandinavian coast, and furnishes an admirable array of fresh data for the study of the problems of regional metamorphism. Dr. Reusch's previous researches on the compressed conglomerates and metamorphosed fossiliferous rocks of the same district were of the utmost value in the discussion of the question, and he now augments these by new details from the surrounding region.

Especially important are the numerous illustrations of the effects of pressure and stretching in the production of the well-known structures of the crystalline schists. The strangely deceptive resemblance to stratification resulting from these processes is exhibited in many examples. Excellent instances are likewise given of the production of foliation in dykes. Eruptive diabases and gabbros are shown to pass into dioritic rocks, and hornblende schists and granite into various foliated compounds. More novel features of the essay are the careful studies of the deformation and foliation of what were unquestionably at one time ordinary sedimentary deposits—sandstones, conglomerates, and limestones. It is shown, for instance, that in a mass of still recognizable conglomerate the planes of stratification are cut across, almost at right angles, by those of foliation, while the lines that mark the direction of stretching or deformation slant upwards across the latter.

Dr. Reusch brings forward some remarkable observations regarding the connection between conglomerates and granitic rocks. He thinks that in some places what is now granite has resulted from the metamorphism of what was originally a breccia or conglomerate composed of fragments of granite, gneiss, quartzite, and quartz. The quartzite and quartz, being less liable to change, remain still visible, while the granite and gneiss have passed into common granite. In another locality he

finds what he believes to be evidence of the passage of a conglomerate into augen-gneiss. Without in any way calling in question the accuracy of his observations, a geologist who has had much experience among the crystalline schists in districts where great thrust-planes and other proofs of powerful displacements prevail, will recall examples of breccias that might at first be taken to be sedimentary masses, but which have eventually proved to be portions of rocks crushed during the disturbances that produced the schistose structure. Coarse pegmatites, for example, may be traced through various stages of comminution, until they pass at length, along the plane of movement, into finely fissile rocks, that in some cases might be mistaken for shales, in others for eruptive rocks with the most exquisitely developed flow-structure. The "eyes" in some augen-gneisses are almost certainly fragments resulting from the crushing of largely crystalline rocks, such as coarse pegmatites.

Dr. Reusch shows that in Scandinavia, as in the north-west and north of the British Isles, the axes of the great terrestrial plications run, on the whole, from north-east to south-west, and that as they have involved Upper Silurian strata in their folds, the movements must be of later date than some part, if not the whole, of the Upper Silurian period. His essay is most welcome as a valuable contribution to one of the most perplexing problems in geology. It once more shows him to be a careful and intrepid field-geologist, and, at the same time, a skilful worker with the microscope. This combination of qualifications fits him in a special manner for the researches to which he has devoted himself with so much ardour and success. His volume is copiously illustrated with figures in the text, and a selection of coloured geological maps. English geologists will also welcome in it a copious English summary of the contents. We may confidently predict that, before long, some of his drawings will be reproduced in the text-books as standard representations of the facts of regional metamorphism. A. G.

TRAVELS IN ARABIA DESERTA.

Travels in Arabia Deserta. By C. M. Doughty. 2 Vols. (Cambridge: University Press, 1888.)

MR. DOUGHTY'S book takes us back to the age of the old travellers. His wanderings were in countries where not only no European had preceded him, but where he had to travel with his life continually in his hand. He travelled alone, and without any of the equipment which the modern explorer considers a necessity of existence, living with the Beduin of the desert, and sharing with them their wretched subsistence. Even the style in which he writes is a style in which it is safe to say no Englishman has written for the last two hundred years, and while it attracts us by its quaintness it makes us not unfrequently wonder what is exactly the author's meaning. Indeed, were it not for the very excellent index, it would often be almost impossible to find one's way through the labyrinth of Mr. Doughty's sentences or to ascertain the exact chronology of his route.

Mr. Doughty seems to have been born under an evil

star. While he possesses most of the requisites of a successful traveller—a love of adventure, an insatiable curiosity, indomitable patience, and extraordinary powers of endurance—he lacks, on the other hand, just those qualities which would have smoothed his journey and made his life more comfortable. He is a man, by his own confession, of blunt and plain speech, improvident and forgetful, with an old-world belief in the falsity of Mohammedanism and the Koran, and the iniquity of countenancing them even by a politic word. His explorations took place at the time of the war between Turkey and Russia, when the fanaticism of the Mohammedans of Arabia was excited to the utmost, and he had to leave Damascus at the outset of his journey without any letters or help from the British Consul. The latter, indeed, declared that "he had as much regard of" him, would he "take such dangerous ways, as of his old hat." It is no wonder that Mr. Doughty complains of conduct which caused him "many times come nigh to be foully murdered."

His explorations were conducted in Central Arabia, a country which is less known than Central Africa. He accompanied the Mecca pilgrims as far as "the kella" or fort of Medain, where he lived with the Turkish garrison, visiting from time to time the ruins of Medain Salihh, and taking squeezes of the Nabathean inscriptions there. After some months he joined the nomad Beduin, and wandered with them in various directions, visiting the lava crags on the west and Teyma on the north-east. Eventually he made his way to Háyl in the Nejd—a centre of Wahabi fanaticism—where a sort of settled government was established under Ibn Rashid. From Nejd he was forwarded, along with some Beduin, to Kheybar, not far to the north of Medineh, where he found himself once more within what was nominally Turkish territory, and was arrested as a spy. Released after a while, he was sent back again, for reasons which are never explained, to Háyl, and here his troubles began. The people of the place would not receive the Christian stranger a second time; his Beduin escort were afraid of bringing him back to Kheybar, and after a series of misadventures he was finally deserted near Aneyza, a town considerably to the south of Háyl. The governor and leading merchants of Aneyza fortunately befriended him, and he at last found his way to Taif and Jedda, though not without being first stripped of the little that still belonged to him, and narrowly escaping with his life.

Mr. Doughty was a careful observer, and he has not only made important additions to our geographical knowledge of Arabia, but also to our geological knowledge of it. The inscriptions he obtained at Medain Salihh and elsewhere have been published by the French Government, and important inferences have been drawn from them. They prove not only that a powerful and civilized State existed in this part of Arabia far on into the Christian era—a fact which was already known—but that this State was Nabathean in its language and character. Mr. Berger has come to the conclusion that before the rise of Mohammedanism the Arabic of the Koran was the language of Mecca only and the surrounding district, the Nabathean with its Aramaic affinities prevailing in the northern part of Arabia, and the Himyaritic in the south. It seems clear, at all events, that the Nabathean